Geodynamics monitorization using wireless sensor networks

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***Abstract*—A wireless sensor network application used to monitor earthquake and assess risk of urban damage**

Wireless sensor networks are a cheap and versatile solution for monitoring various environments and elements of an environment. There exists a number of such applications used worldwide to monitor areas in which human access is hard or near impossible. The issue with these applications is that they are mainly used by government organizations or for research purposes. They seldom focus on using the data in the interest of safety for the population, such as warning them of natural disasters or assessing the risk of damaged areas left in the wake of a natural disaster. The solution we propose in this article is used to monitor earthquakes and the status of urban structures exposed to earthquakes or other sources of vibration in order to prevent possible disasters.

***Index Terms*—Wireless Sensor Networks, Geodynamics, Earthquake monitoring, Low power**

I. Introduction

In recent years, wireless sensor networks have been used more and more often as a cheap and easy to maintain monitoring system. Wireless sensors are adequate tools for monitoring various environments due to a series of characteristics such as: low power consumption which increases autonomy and helps reduce the node size (no need to attach large batteries), the possibility to attach energy harvesting modules which further help to increase their autonomy and the ability to mount numerous sensor peripherals on a small surface.

Since these sensors communicate via wireless networks, they are ideal tools to use in monitoring remote or otherwise hostile environments such as: underground caverns, ocean floors, volcanic mountain ranges, etc. Another field in which wireless sensors would represent a good monitoring solution is geodynamics. Using such a network, it could be possible to predict natural phenomena such as earthquakes, tsunamis, landslides and volcanic eruptions much faster and with increased precision regarding magnitude and the time of the event. Also, such a solution may prove to be cheaper and more flexible than existing installations deployed for performing these tasks.

Delving even deeper into the utility of such an application, we can take into account that whenever a phenomena amongst those mentioned earlier occurs, the areas which often suffer damages are cities and towns. A good use for a wireless sensor network would be to mount it around cities and on buildings inside the city situated in such danger zones. Thus, whenever an earthquake or other natural disaster occurs, authorities can respond faster and reduce the damage, both material and human lives.

In this paper, we propose a wireless sensor network solution for monitoring earthquakes. The nodes can be mounted on buildings and they will monitor the vibration of the building as well as various other parameters (air pressure, temperature, etc.). Once calibrated to the ”normal” values of the parameters, whenever these parameters go over a threshold value, a system is notified that there is a possible risk of an earthquake happening. More so, this system can be used to determine if a building is exposed to deterioration due to external factors such as proximity to construction site, roads frequented by heavy load trucks, etc.

II. Related Work

Applications which monitor geodynamics using wireless sensor networks have been attempted before. However, most have been used to monitor volcanic activity, tsunamis and building structure integrity but there are seldom any references of attempts to monitor earthquakes directly using wireless sensor networks.

Researchers from Singapore, China and the USA have published a paper describing their implementation of an improved algorithm for WSNs in order to monitor volcanic activity. This new algorithm, using data gathered from the sensors, would determine as accurately as possible and in real time the arrival of primary seismic waves which are produced prior to a volcanic eruption. Although not directly focused on earthquake monitoring, this research provides a starting point for further research and improvements in this area.

Another implementation using WSNs is presented in an article by N. Meenakshi and Paul Rodrigues [1] and focuses on tsunami monitoring using WSNs. They propose a network composed of 3 types of nodes: sensors, commanders and barriers. The sensors are dispersed underwater to monitor the water pressure. This data is sent to commanders which process it and determine if there is any specific area in danger of being

hit by an incoming tsunami, determined by the variations in pressure. If there is any danger, the barrier sensors in that area are notified to activate the barriers.

One more direction in which geodynamics monitoring WSNs have been used is structural integrity of buildings [2]. Especially in urban areas, buildings are often exposed to vibrations caused by various factors: heavy vehicles such as public transport or cargo trucks, proximity to construction sites, etc. In time, such buildings deteriorate and become a danger because they are prone to collapsing. Using such sensors to monitor the vibrations they are exposed to, damage can be prevented by determining if a building is prone to collapsing and if it poses a threat to people and other structures in the area.

REFERENCES

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